WETLAND RESTORATION

(PHASE I - final report)

PROJECT HISTORY

The development of the area in question began June 23, 1986, when an application for a permit to construct a 40.19 acre project known as Gahagan Plantation was submitted to the SCDHEC-OCRM. On July 29, 1986 a project certification was granted by the SCDHEC-OCRM; this project called for the use of a 372,416 cubic foot detention basin, formed by excavating an area adjacent to the Sawmill Branch, in Summerville, SC.

Work on this project began in late 1986, and continued during the entire 1987 year. On March 9, 1987, applications were submitted for approval for two other projects in the same general area. These projects were known as Gahagan Plantation II and Garbon Subdivision. This marked the beginning in a change in thinking that was designed to save wetlands and to use wetlands to improve water quality. The practice of excavating wetlands to create detention ponds would no longer be considered as a suitable design. Special protection would be constructed to preserve the wetlands, while the storm water runoff would serve to replentish nutrients to the wetlands. The natural filtering would improve water quality down stream.

The new plan was incorporated in the original Gahagan Plantation design, and no wetlands were destroyed to create detention ponds. The existing wetlands were used on a larger scale to control storm water runoff. It was learned that the cost of the extra protection measures used to guard the erosion of the wetlands, would in fact cost no more than it would have cost to create the typical detention pond. There was the possibility that the final cost would be less in most cases.

The new project area was increased to 144.67 acres, consisting of Gahagan Plantation I, Gahagan Plantation II, a portion of Gahagan Road, and Garbon Subdivision. The existing wetland that was utilized ,was formed when Sawmill Branch was constructed as one of the main drainage canals serving Summerville, SC as a storm water structure for the Town. The area

used was approximately 7.5 acres, and had an operating level of 41.5 feet msl. This area would detain 467,400 cubic feet of stormwater, with an additional capacity of 178,450 cubic feet available to the minimum height of the retaining berm. (Elevation 42 feet msl) The 100 year flood elevation is 43 feet (plus or minus) msl, and is a function of the backwater from the Ashley River, and the flow in Sawmill Branch. From this information, it was recognized that detaining the 100 year storm would not be possible, since the waters affecting the wetlands area would be originating from offsite sources.

The analysis of the project was made for a 25 year storm frequency. Having a 60 minute time of concentration, and an intensity of 3.7 inches per hour; the site was calculated to have a pre-constuction coefficient of runoff of .35, and a post- construction weighted coefficient of runoff of .548. The required storm water detention was calculated to be 425,590 cubic feet, which gave 41,810 cubic feet of storage surplus, below the 41.5 foot msl elevation.

FACTORS AFFECTING ORIGINAL PROJECT

The combined project was greatly affected by two occurrences that changed the manner of how the wetlands would be affected. First, the owner of the project suffered a drastic change in financial fortune based on factors outside of the immediate concern of the project. This changed the relationship of the owner to the project, since the project was secured by lending institutions as payment of other debts. Secondly, the entire wetlands management plan was placed in doubt when a storm occurred while Sanitary Sewer work had the main ditch system blocked. This caused the berm system to be breached, depositing a substancial amount of erosion silt into Sawmill Branch. The owner was in no position to remedy the problem, and the Town of Summerville stepped in and secured the berm. The means used to secure the berm released a majority of the storm water directly to the Sawmill Branch as a least cost emergency fix to the problem. During the time after this occurred, attention was diverted to other more immediate

concerns caused by Hurricane Hugo. During the years after Hugo, it was discovered that the wetlands were drying up.

WORK of the RESTORATION PROJECT

Through the efforts of the SCDHEC - OCRM, and the Charleston Harbor Project, a program to correct the effects of past events concerning this development was initiated. With the corrections in place, water quality would be improved to the levels once sought for the area.

Initial investigation made two facts obvious. The wetlands were drying up because two of the outlet pipes beneath the retaining berm had been layed too low. Also, in order to manage water quality, the effects of the emergency fix provided by the Town of Summerville, SC would have to be changed.

The first measure taken was to control all runoff from frequent rainfall so that it entered the wetland area where filtering could occur. This was accomplished by installing a diverter structure that controlled all flow in the system that occurred below elevation 41.0 msl. This measure also assured that all of the wetlands would be fed a supporting source of moisture on a regular basis. The system would divert all stormwater from the first inch of rainfall, and capture the first flush conditions that would occur, and allow these conditions to be filtered. Secondly, the existing outlet beneath the berms were changed by additional pipe structures so that the lost of water could be controlled. This was done in a manner that would be compatible with the previous design for stormwater management. The additional design provides a means of maintaining a pool elevation of 39.0 feet msl which is the original beginning point for storage of stormwater detention. This level is adjustable should future findings deem such adjustment to be desired. The redesigned system allows filtering action between the elevations of 36 feet and 41.2 feet msl. Freguently occurring stormwater levels can be effectly treated without

accummulating amounts that would cause concern in the surrounding areas. This restoration project has been conducted with special thought given to ensure that the system would continue to function when storms of unusual magnatude occur. It was recognized that the majority of water quality issues are affected by storms that frequently occurr, and will have the greatest effect for storms giving a little as one half inch of runoff.

Submitted By

Thomas W. Kennedy,Jr.,P.E.& L.S.

Thomas W. Kennedy, Jr., P.E. & L.S.

Consulting Engineer • Land Surveyor • General Contractor

September 3, 1996

Mr. J. Heyward Robinson
Charleston Harbor Project
SCDHEC - OCRM
1362 McMillan Ave., Suite 400
Charleston, SC 29405

Re: CHP Project 319 - 1.0

Dear Mr. Robinson:

In response to your inquiry regarding the level of rainfall needed to produce a discharge from the wetland detention area, I have determined that too many factors are related to determining this event, to make a call.

The presents of the Sawmill Branch so near to the area, produces a natural loss of ground water at a rate that cannot be determined with any accuracy. The diverter structure releases runoff with respect to the depth of flow reaching the structure, therefore the magnatude and duration of the storm event could have varying results regarding discharge from the system. Since the system has been installed, there has been no discharge from the system. The true volume of detention is in question below the 39.0 feet msl level. The volume below this level was not used in calculating the effects of the 25 year storm event because it was known to be affected by irregular ground conditions that may have not been picked up by topographic survey.

As I understand, sampling of the system discharge must be scheduled in advance. I regret that I am not in a position to aid in making this schedule. I would recommend that an automatic sampling device be developed for this purpose. I would be available to aid in developing such a system if my aid would be helpful. If I can be of further assistance with this project please call.

Sincerely,

T.W. Kennedy Jr.

Thomas W. Kennedy, Jr.,P.E.& L.S.

encl:

P.O. Box 1111 • Mt. Pleasant, S.C. 29465 • Telephone (803) 556-6752

ASHLEY RIVER STORMWATER WETLAND RESTORATION PROJECT

PHASE I

GAHAGAN SUBDIVISION

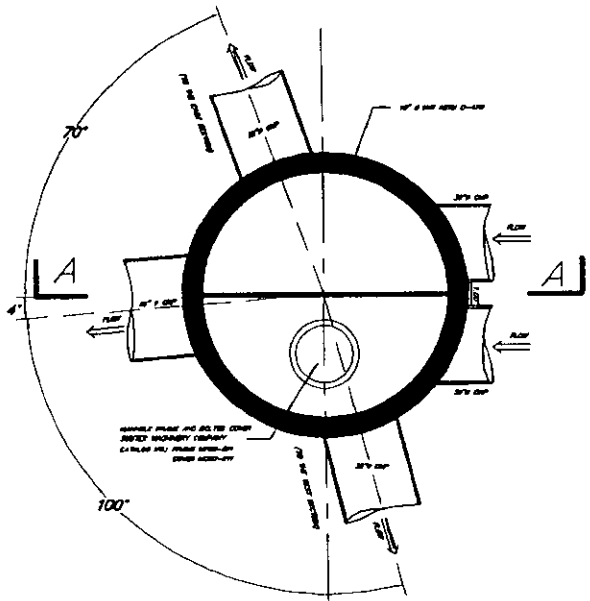
LOCATED IN

SUMMERVILLE, SOUTH CAROLINA

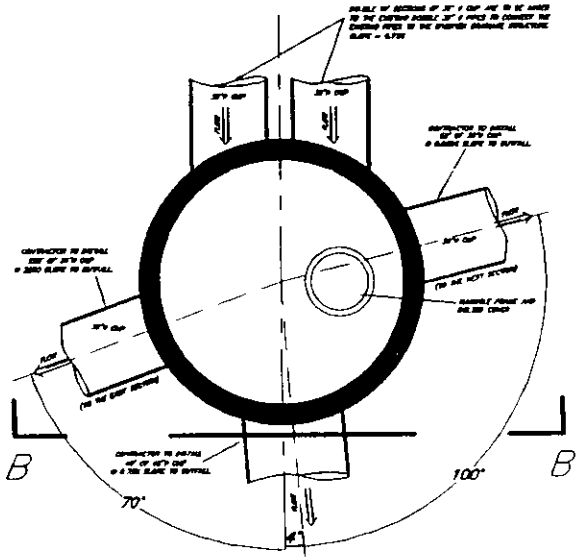
INDEX

TRICO ENVIROMETRICS INC.
4055 FABER PLACE DRIVE, SUITE 201
NORTH CHARLESTON, SOUTH CAROLINA 29405
(803) 740-7700

DIVERTER DRAINAGE STRUCTURE



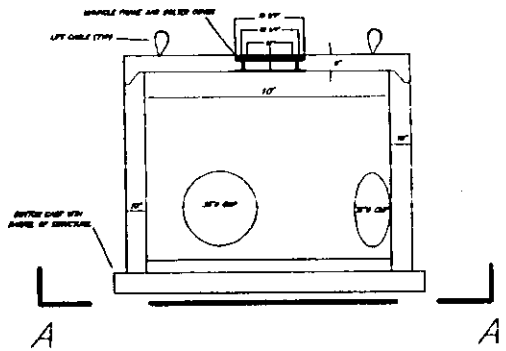
PLAN VIEW



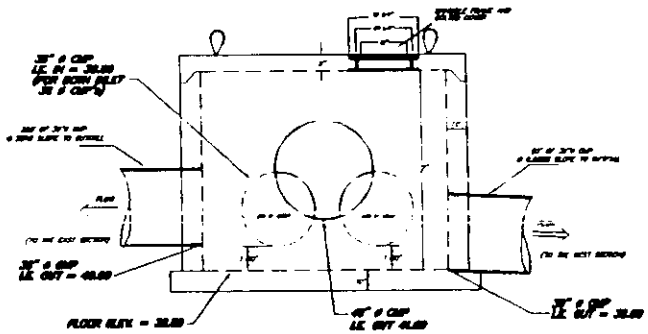
PLAN VIEW

NOTE:

1. ALL CMP TO BE INSTALLED MUST BE SMOOTH BORE, FULLY BITUMINOUS COATED PIPE.
   NORTH AMERICAN CULVERT CORP. SMP-405 SHAPE 3 "A" OR EQUAL.
   (AAHSTO M36 TYPE 2 & AASHTO M190 TYPE A.)

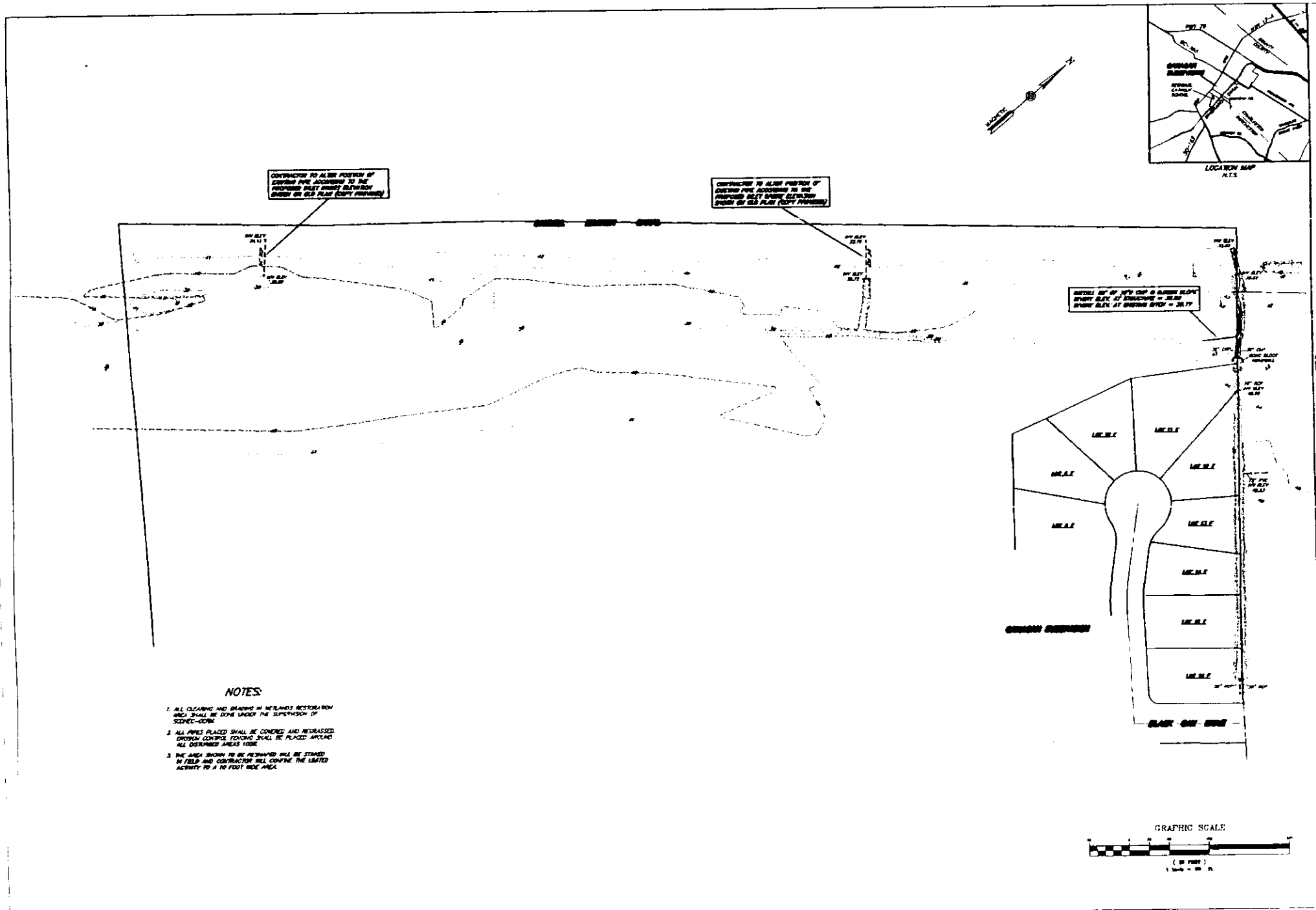


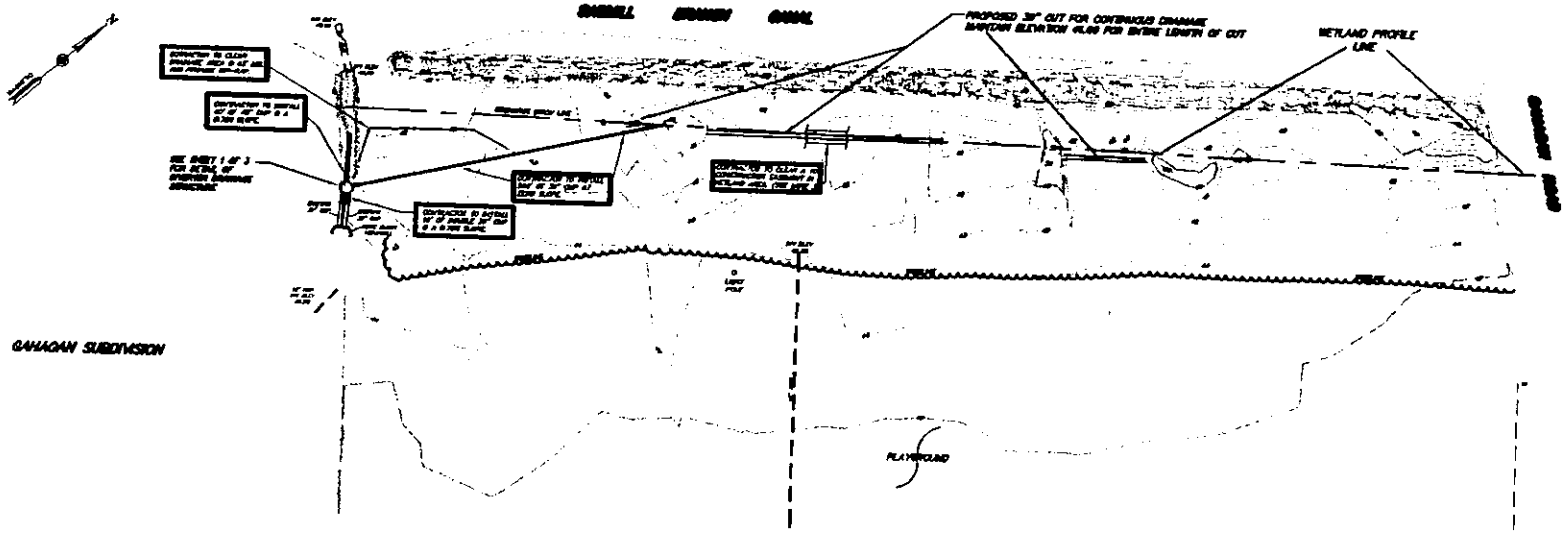
SECTION A–A

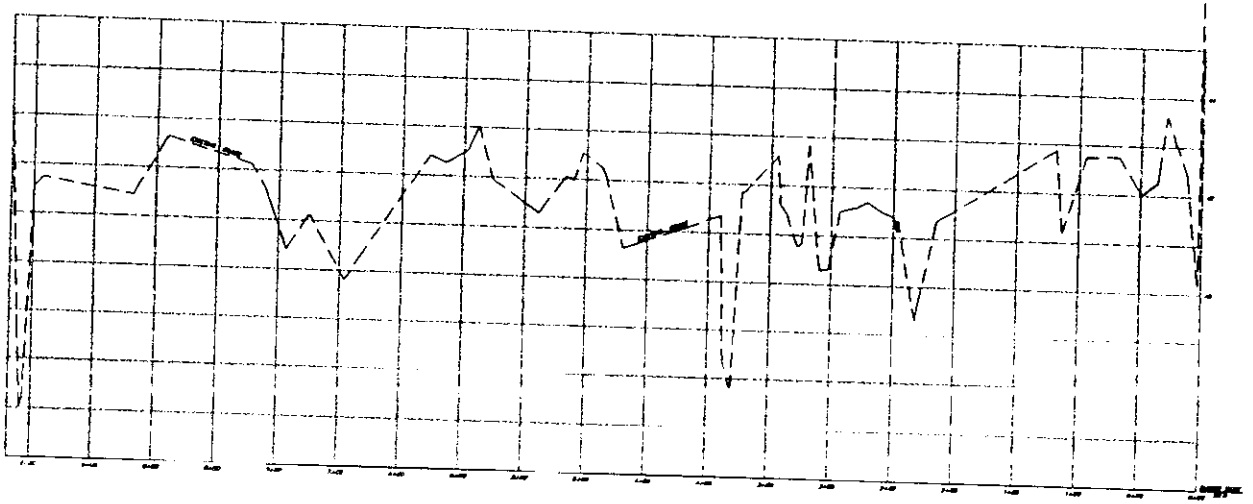


SECTION B–B

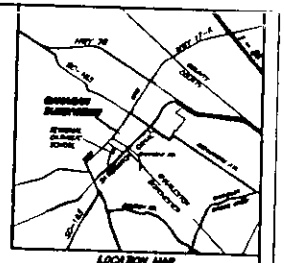
TITLE
DIVERTER DRAINAGE STRUCTURE
ASHLEY RIVER STORMWATER


LOCATION MAP
N.T.S.
GRAPHIC SCALE
NOTES:
1. ALL CLEARING AND GRADING IN WETLANDS RESTORATION AREA SHALL BE DONE UNDER THE SUPERVISION OF SCIENCE-CORM.
2. ALL PIPES PLACED SHALL BE COVERED AND REGRASSED. EROSION CONTROL FENCING SHALL BE PLACED AROUND ALL DISTURBED AREAS 100E.
3. THE AREA SHOWN TO BE REGRADED WILL BE STAKED IN FIELD AND CONTRACTOR WILL CONFINE THE LIMITED ACTIVITY TO A 10 FOOT WIDE AREA.
SITE PLAN (WEST SECTION)





WETLANDS PROFILE



LOCATION MAP
N.T.S.

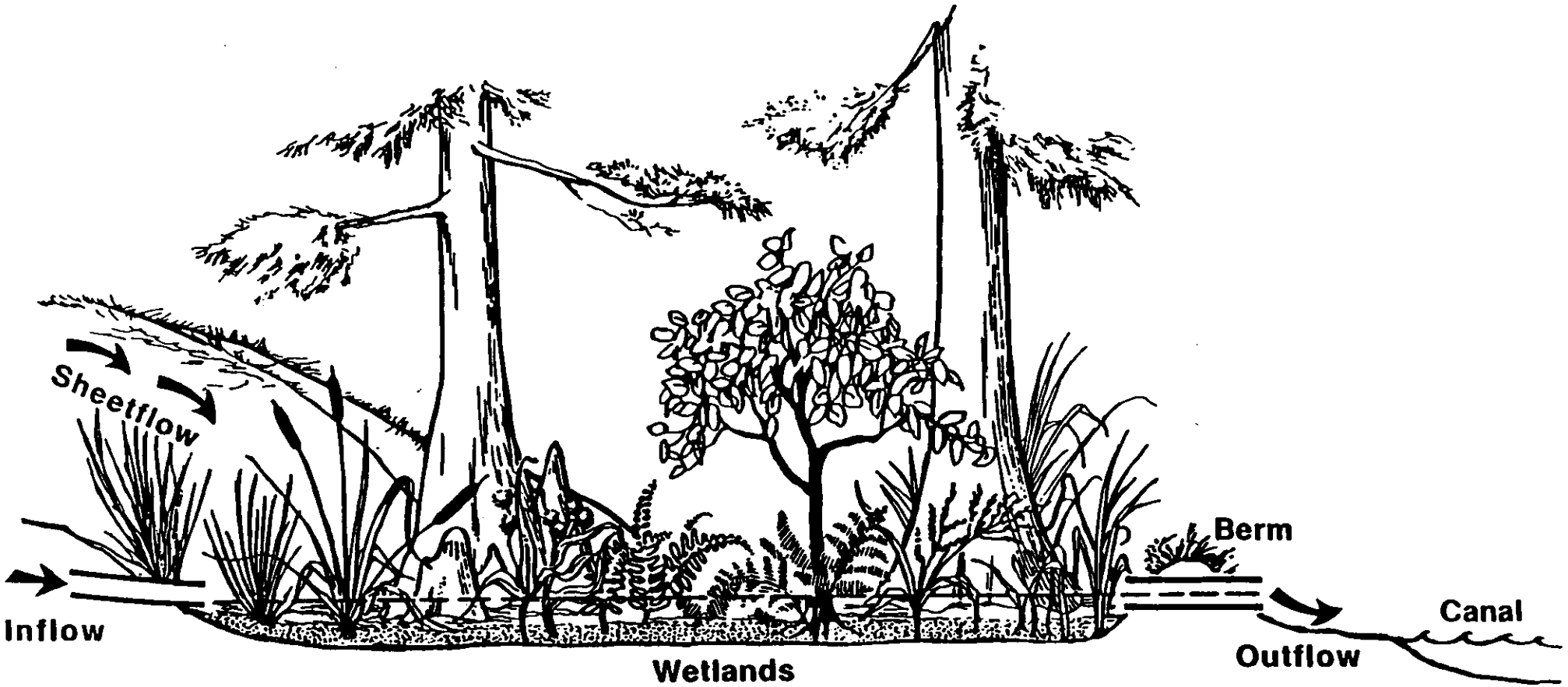
NOTES:

1. ALL CLEARING AND GRADING IN WETLANDS RESTORATION AREA SHALL BE DONE UNDER THE SUPERVISION OF SCIMEC-GOMM.
2. ALL PIPES PLACED SHALL BE CENDREX AND INTERLOCKED. EROSION CONTROL FENCING SHALL BE PLACED AROUND ALL DISTURBED AREAS 100%
3. THE AREA SHOWN TO BE REGRADED WILL BE STAKED BY FIELD AND CONTRACTOR WILL CONFINE THE LIMITED ACTIVITY TO A 10 FOOT WIDE AREA.

GRAPHIC SCALE

TITLE
SITE PLAN (EAST SECTION)

Concrete Diverter Structure



Conceptual Drawing of Wetland Detention System

BASELINE MONITORING OF VEGETATION TRANSECTS

FOR THE SAWMILL BRANCH

WETLAND RESTORATION PROJECT

to monitor long-term biological changes in the wetland vegetation community as a result of the restored hydrology

conducted by

USACOE in conjunction with SCDHEC/OCRM

on May 23, 1996

Gahagan Subdivision Wetland Restoration Project

Charleston Harbor Project Special Project

Description of existing conditions and dominant vegetation

A site inspection was performed at the above referenced site on May 23, 1996. This inspection and assessment were performed by Jeff Thompson of OCRM and Jake Duncan of USACOE. The findings are as follows.

The project site is a remnant wetland community associated with Sawmill Branch, a channelized stream system in Dorchester County, South Carolina. This wetland has experienced significant modification due to channelization of the stream system. Hydrology has been reduced and the vegetative community is likely to experience long term changes in species distribution. Restoration activities performed at this site should enhance hydrology and reduce the likelihood of long term vegetative community changes. The existing community is bottomland hardwood with distinct canopy, sub-canopy, shrub, and herbaceous layers.

Canopy species: Gordonia lasianthus, Acer rubrum, Quercus larifolia, Leriodendrun tulipifera, Ilex opaca, Liqidambar styraciflua, and Pinus elliotteii.

Sub-canpopy: Ligustrum sinense, Magnolia virginiana.

Shrubs: Lucothoe axillaris, Lyonia lucida, Itea virginica, Persea borbonea, Simplocus tinctoria, and Viburnum dentatum.

Ferns: Osmunda regalis, Osmunda cinnomenea, Woodwardia areolata, and Thelipterus sp.

Vines: Rhus radicans, Smilax rotondifolia, Smilax glaucus, Decumeria barbara, Berchemia scandens, Vitus estavalis, Lonicera japonica, Parthinocisous quinqifolia, and Vitus vulpina.

Relic stumps and knees of bald cypress were noted. It would be anticipated that cypress may return as hydrology is increases by the restoration activities.

Appendix A

Summary of Storm Water Detention Calculations

PRE DEVELOPMENT RUNOFF VALUES

AREA	144.67 AC
T.C.	USE 60 MIN. SEE GAHAGAN I PLANS
I	3.70 : 25 YEAR STORM
COE RUNOFF	0.35

PRE DEV. Q = C.I.A.
PRE DEV. Q = (0.35)(144.67)
PRE DEV. Q = 187.35 CFS

POST DEVELOPMENT RUNOFF VALUES

AREA	144.67 AC.
COE.	0.548

GAHAGAN I	ACRES	PERCENTAGE	COE	EQUALS
SUBDIVISION	13.32	0.09	.50	.45
COMMERCIAL	3.90	0.03	.95	.029
CHURCH	3.00	0.02	.95	.019
SCHOOL	12.00	0.08	.95	.076
ROAD	1.20	0.01	.50	.005
POND	3.20	0.02	.95	.019
MISC.	1.64	0.01	.30	.003
SUB TOTAL	38.26			
GAHAGAN II				
SUBDIVISION	19.32	0.13	.50	.050
GARBON SUBDIVISION				
SUBDIVISION	85.27	0.59	.50	.295
GAHAGAN ROAD				
1200 LF S 66FT	1.82	0.01	.65	.007
				0.548
GRAND TOTAL	144.67 AC			

DURATION (MIN.)	RAINFALL (25 YR) INCHES	RUNOFF RATE (A)(C)(I)	RUNOFF VOLUME (CFS)(DUR) (60)	OUTFALL VOLUME (Q PRE)(DUR) (60)	DIFFERENCE
5	8.3	658.02	197406	56205	141201
10	7.2	570.81	342486	112410	230076
15	6.5	515.31	463779	168615	295164
20	5.9	467.74	561288	224820	336468
25	5.5	436.04	654060	280025	374035
30	5.1	404.32	727776	337230	390546
35	4.8	380.54	799134	393435	405699
40	4.4	364.68	875232	449640	425592
45	4.3	340.90	920430	505845	414585
50	4.0	317.12	951360	562050	389310
55	3.8	301.26	994158	618255	375903
60	3.6	285.40	1027440	674460	352980

THE MASS CURVE METHOD ABOVE INDICATES A MAXIMUM DIFFERENCE IN STORM WATER RUNOFF BETWEEN EXISTING AND POST DEVELOPMENT CONDITIONS OCCURS AT A 25 YEAR FREQUENCY STORM OF A 40 MINUTE DURATION, AT APPROXIMATELY 425,592 C.F.S. THEREFORE THE DETENTION REQUIRED FOR THIS PROJECT IS 425600 C.F. WHEN THE ENTIRE 144.67 ACRES ARE DEVELOPED.

EXISTING DETENTION VOLUME IN WETLANDS AREAS

1. AREA OF ELEVATION 39.0 = 7000 S.F.
   AREA OF ELEVATION 40.00 = 161000 S.F.

   VOLUME BETWEEN ELEVATION 39.00 & 40.00

$$\frac{[7000 \text{ S.F.} + 16100 \text{ S.F.}]}{2} \times 1 \text{ FT. DEEP} = 84000 \text{ C.F.}$$

2. AREA OF ELEVATION 40.0 = 161000 S.F.
   AREA OF ELEVATION 41.0 = 335000 S.F.

   VOLUME BETWEEN ELEVATION 40.0 & 41.0

$$\frac{[161000 \text{ S.F.} + 335000 \text{ S.F.}]}{2} \times 1 \text{ FT. DEEP} = 248000 \text{ C.F.}$$

VOLUME BELOW 41.0 + 332000 C.F.

3. AREA OF ELEVATION 41.0 = 335000 S.F.
AREA OF ELEVATION 41.5 = 394000 S.F.

VOLUME BETWEEN ELEVATION 41.0 & 41.5
$\frac{[335000 \text{ S.F.} + 394000]}{2}$ X .5 FT. DEEP = 182250 C.F.

VOLUME BELOW 41.5 = 514250 C.F.
VOLUME REQUIRED = 425590 C.F.

DIFFERENCE SURPLUS [88660]
STORAGE

4. AREA OF ELEVATION 42.0 483000 S.F.
AREA OF ELEVATION 41.5 394000 S.F.

VOLUME BETWEEN ELEVATION 41.5 & 42.0
[483000 S.F. + 394000] X .5 FT. DEEP = 219250 C.F.

VOLUME BELOW ELEVATION 42.0 = 733500 C.F.
TOP OF BERM

OUTFALL PIPE DESIGN

PRE DEVELOPMENT RUNOFF 187.35 CFS

PIPE NO. 164	24" Ø RCP	50.00 CFS
PIPE NO. 189	24" Ø RCP	50.00 CFS
PIPE NO. 192	18" Ø RCP	30.00 CFS
PIPE NO. 194	18" Ø RCP	34.00 CFS
PIPE NO. 195	15" Ø RCP	23.00 CFS

Sawmill Branch (Dorchester Creek)					
Date	1/13/95	1/13/95	1/13/95	1/13/95	1/13/95
Time	1940	2025	2055	2250	2335
Flow (Q= x cubic feet/second)	50.8	130	160	175	217
Water Temperature, degrees Celsius	15.4	16.5	16.5	16.2	16.9
Barometric Pressure (mm of HG)	760	760	768	760	760
Rainfall accumulated (inches)	0.33	1.09	1.11	1.13	1.14
Specific Cond., microsiemens/cm @ 25 deg. C.	168	154	163	144	150
Oxygen dissolved, (mg/L)	9.4	9.4	9	8.5	8.8
Biochemical Oxygen Demand, 5-day @ 20 deg. C (mg/L)	1.8	2.9	2.9	3.9	2.4
pH, Water, Whole, Field, Standard Units	7.9	7.7	7.7	7.6	7.6
pH, water, whole, laboratory, standard units	7.2	7.2	7	7.1	7.1
Nitrogen Ammonia, dissolved (mg/L as N)	0.04	0.04	0.04	0.03	0.03
Nitrogen Ammonia plus organic total (mg/L as N)	0.5	0.4	0.5	0.9	0.6
Phosphorous total (mg/l as P)	0.07	0.09	0.18	0.46	0.41
Phosphorous Orthophosphate, dissolved (mg/l as P)	0.04	0.06	0.12	0.09	0.07
Phosphorous, Hydrolizable plus Ortho total (mg/l as P)	0.05	0.18	0.57	0.62	0.4
Calcium, dissolved (mg/L as Ca)	18	20	21	20	16
Magnesium, dissolved (mg/L as Mg)	1.5	1.3	1.2	1.2	1.2
Sodium, dissolved (mg/L as Na)	9.5	7.7	6.1	6.9	7
Poatssium, dissolved (mg/L as K)	0.9	0.7	0.9	1.3	1
Chloride, dissolved (mg/L as Cl)	13	10	9.5	8.2	8.9
Silica, dissolved (mg/L as SIO2)	6.3	5.2	4.4	4.1	5.4
Barium, dissolved (mg/L as Ba)	19	15	13	13	16
Beryllium, dissolved (mg/L as Be)	0.5	0.5	0.5	0.5	0.5
Cadmium, dissolved (ug/L as Cd)	10	10	10	10	10
Chromium, dissolved (ug/L as Cr)	1	1	1	1	1
Copper, dissolved (ug/L as Cu)	10	10	10	10	10
Iron, dissolved (ug/L as Fe)	430	310	190	290	350
Lead, dissolved (ug/L as Pb)	100	100	100	100	100
Manganese, dissolved (ug/L as Mn)	15	17	16	18	13
Molybdenum, dissolved (ug/L as Mb)	1	1	1	1	1
Stronium, dissolved (ug/L as Sr)	47	46	51	43	38
Zinc, dissolved (ug/L as Zn)	10	12	5	13	9
Lithium, dissolved (ug/L as Li)	4	5	5	5	5
Fecal Coliform, .7 UM-MF (Col./100mL)	5600	6600	12000	11000	5600
Density (gm/mL @ 20 deg. C.)	0.998	0.998	0.998	0.998	0.999
Mercury, dissolved (ug/L as Hg)	0.2	0.1	0.2	0.1	0.1
Specific Conductance, microsiemens/cm @ 25 deg. C	154	154	168	149	128
Alkalinity, titration to pH 4.5, Laboratory (mg/L as CACO3)	43	43	54	49	38

Results for wetlands pre-restoration sampling event
Gahagen subdivision, Summerville, SC
October 31, 1995

Sample number	SSB1	SSB2	SSB3	SSB4	SSB5	SSB6
Time (EST)	1115	1200	1240	1325	1410	1615
Rain (inches)	trace	0.06	0.15	0.19	0.21	0.22
Discharge (cfs)	0.16	0.92	1.50	0.58	0.21	0.17
pH	8.01	7.83	8.79	7.60	7.59	7.57
Temperature (°C)	18.5	18.8	19.6	19.2	19.3	19.4
Specific conductance (µS)	164	183	112	108	139	166
Dissolved oxygen (mg/L)	9.2	8.8	8.0	8.2	8.2	8.2
Suspended sediment (mg/L)	15	122	896	269	136	37
Sand/Silt split (% finer than 0.062 mm sieve)	86.8	68.0	86.5	87.0	66.8	87.8
Total suspended solids (mg/L)	7.5	160.8	831.2	239.6	41.4	114.7

Water-Quality Sample, Pre Restoration, 10/31/95